



# AMSAT<sup>TM</sup>

Affiliated with



## NEWSLETTER

Price 50¢

Issued quarterly by the Radio Amateur Satellite Corporation

Volume V

Number 2

June 1973

### AMSAT OFFICERS

**President:**  
Perry I. Klein K3JTE

**Executive V.P.:**  
Jan A. King W3GEY

**V.P. Engineering:**  
George Kinal WA3TRL

**V.P. Operations:**  
William A. Tynan W3KMV

**Secretary:**  
Charles Dorian W3JPT

**Treasurer:**  
William A. Hook W3QBC

**Editor:** Thomas H. Mitchell  
WA3TBD

### Contents

|                                                      | Page           |
|------------------------------------------------------|----------------|
| Editorial: "97.1(b)"                                 | 2              |
| AMSAT Nets                                           | 2              |
| From The President's Desk                            | 3              |
| Acknowledgements of Donations                        | 4              |
| Minutes of Board of Directors Meetings               | 4              |
| In Memory of Our Friend "Cap" Petry                  | 7              |
| OSCAR 6 Operating Schedule                           | 8              |
| Satellite Operating Awards                           | 8              |
| Preliminary Observations on OSCAR 6 Inverted Doppler | 10             |
| NOTICE OF ANNUAL MEETING and BALLOT FOR DIRECTORS    | center section |
| Narrow-Band Facsimile Through OSCAR 6                | 14             |
| OSCAR 6 QSL Lists Needed!                            | 18             |
| Letter                                               | 19             |
| Elevation--How Important Is It?                      | 19             |

Material published in the AMSAT Newsletter  
may be reproduced without specific permission  
provided credit is given to the source.

AMSAT  
P.O. Box 27  
Washington, D.C. 20044



FIRST CLASS  
U.S. POSTAGE  
PAID 8c  
Permit No. 44367

FIRST CLASS

FIRST CLASS MAIL

by Tom Mitchell, WA3TBD

"Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art . . ."

These words, which should be familiar, are one of the major fundamental purposes of the Amateur Radio Service as set forth by FCC. They are words we can be proud of . . . especially if enough of us continue on in this tradition.

In this issue we have some information of investigation and research into a phenomena which, if its existence is proven, will no doubt be considered a major contribution to knowledge in the physical sciences. (See the article on "Inverse Doppler" elsewhere in this issue.)

Those of us who, for one reason or another, are unable to assist in this type of investigation should highly commend those who can and do. Taking the time to make the meticulous observations and calculations needed to document a phenomenon of this type takes a real dedication.

Whether or not these efforts, or similar ones, result in significant contributions to knowledge, everyone who supports AMSAT can feel that they are supporting one of the most worthwhile of amateur radio's scientific quests in pursuit of the above mentioned "fundamental purpose."

#### AMSAT Nets

The following AMSAT nets are now in operation:

##### North America East Coast 75 Meter AMSAT Net

Mondays 9:00 p.m. EDT (0100Z Tues)

3855 KHz LSB

Net Control: W3ZM or W3TMZ

##### North America West Coast 75 Meter AMSAT Net

Mondays 8:00 p.m. PDT (0300Z Tues)

3850 KHz LSB

Net Control: W6DMN or W6BGJ

##### International 20 Meter AMSAT Net

Sundays 1800 Z

14,280 KHz USB

Net Control: W3ZM or others

##### International 15 Meter AMSAT Net

Sundays 1900Z

21,280 KHz USB

Net Control: W3ZM or others

##### European 40 Meter OSCAR 6 Net

Sundays 0930Z

7070 KHz LSB

##### European 80 Meter OSCAR 6 Net

After passes on ON days

3780 KHz LSB

In addition, the frequencies 3855 KHz (LSB) and 14,280 KHz (USB) are being used as general watch frequencies for satellite information after passes.

In the Washington area AMSAT traffic is handled via 2 meter FM on 146.85 MHz simplex and through the AMSAT repeater 146.25 to 146.85 MHz. Those interested in satellites in other parts of the country are urged to use these same frequency combinations where possible. If a repeater is already on 25/85, get on it. If not, try to set one up or use 146.85 simplex. In this way we can all communicate more easily with each other when traveling.

#### FROM THE PRESIDENT'S DESK

By Perry I. Klein, K3JTE

OSCAR 6, first in the series of AMSAT-OSCAR-B missions, continues to operate satisfactorily after eight months in orbit. During the first week in May, the operating schedule was modified making the translator available for communications on Thursdays, Saturdays and Mondays, Greenwich Mean Time, and OFF on other days. The purpose of this change was to subject the nickel-cadmium battery to shorter, more frequent charge-discharge cycles. This procedure appears to be working well, and may well extend the useful lifetime of the spacecraft.

The temperature of the battery, which had risen to as high as 47° C. (117° F.) in early February and had been a cause for concern, has now dropped to a more comfortable value. There is now no reason to believe that we will not achieve the one-year planned lifetime, and possibly even exceed it, although we may find it necessary to further modify the operating schedule from time to time in an attempt to extend OSCAR's operating life to the maximum possible.

As many of the users of OSCAR 6 have noticed, we have initiated AMSAT official bulletin transmissions through the satellite translator, and these are generally given on the reference orbits (the first orbit of each Greenwich day, the same orbit during which the satellite is turned on briefly for telemetry recording on the OFF days). VE2BYG, K1HTV, W3TMZ and K7BBO have been serving as AMSAT Official Bulletin Stations for these transmissions, which include reports of special experiments and any changes in the operating schedule.

We can now identify the calls of some 1,100 stations who have made one or more contacts via OSCAR 6, very nearly half of these stations being outside the USA. These include stations from 59 countries, including CT2, DL, DU, EA, EI, F, FC, FP8, G, GI, GM, GW, HA, HB, HG, HK, I, JA, KP4, KX6, LA, LX, LU, LZ, OE, OH, OH8, OK, ON, OX, OZ, PA, PY, SM, SP, SV, TF, UA1, UB5, UC2, UG6, UJ8, UR2, UW6, VE, VK, VK8, VP2V, VP9, VU, W, LX, YU, ZE, ZL, ZS, 4X, 6Y, and 8P.

In the United States, all 50 states except the state of Nebraska have been on at one time or another, although more activity is needed in Idaho, La., Kentucky, Montana, Nevada, Vermont and Wyoming, as only spotty activity has been reported from these states. The number of stations on from each of the US call areas is W1: 38; W2: 64; W3: 47; W4: 64; W5: 34; W6: 91; W7: 53; W8: 30; W9: 61; W0: 52; KH6: 2; KL7: 5. We have one report of operation from VE8, and activity in Africa, South America and the Far East also seems to be very sparse. We urge members in these regions to equip for satellite operation during the coming months.

The operator apparently leading with the most reported satellite contacts is K7BBO with over 3,300 QSO's (Dave is averaging about 500 satellite QSO's a month), and several stations now have over 45 states confirmed through the satellite.

A special message commemorating World Telecommunication Day was transmitted over OSCAR 6's Codestore message storage system on May 17 using the 29.45 MHz beacon.

The first reported aeronautical mobile communication via OSCAR 6 was by W6OAL, who reported working K7BBO April 27th on Orbit 2431 over a distance of approximately 5,000 miles. The transmitter aboard the aircraft was a Gonset Sidewinder operating on SSB with less than 5 watts PEP to a simple whip antenna.

W2GN for the past several months has been quite successful with an automobile OSCAR terminal, and has been very popular with his special state DX-peditions to Vermont and Kentucky to put these rare states on the air. AMSAT is encouraging more mobile terminal operation with OSCAR 6. In particular, operation from small private aircraft, small boats and automobiles (especially on SSB) would provide a very effective demonstration of the usefulness of amateur satellites for small-terminal communication. In addition, operation using totally hand-held equipment or operation from a bicycle or motorcycle would be impressive "firsts," and we urge anyone interested in these activities to give it a try. If possible, make tape recordings of some of the mobile contacts and send them to AMSAT.

---

AMSAT gratefully acknowledges recent donations of \$25.00 or more from the following:

|                                                     |                               |
|-----------------------------------------------------|-------------------------------|
| The American Radio Relay League                     | C. Stanley Leaf - K8MYN       |
| S. M. Bedford, Jr. - WB4SJT                         | Richard E. Lee - K4BAP        |
| Robert E. Crumrine - WB2DNN                         | R. S. Long - WA4JID           |
| Lloyd Ferns - VE3BZF                                | McIntosh Laboratory, Inc.     |
| Hank Fitz - W4URU                                   | Fred J. Merry - W2GN          |
| Foundation for Amateur Radio<br>(Washington, D. C.) | George M. Orr                 |
| George H. Gray - W8UWV                              | Ottawa Amateur Radio Club     |
| Stephen J. Hay, Jr. - K5R2U                         | Edgar C. Steebe, Jr. - WA2RDE |
| John L. Hill - W8ZWW                                | Jerry S. Stover - W5KZN       |
| International Amateur Radio<br>Union - Region 1     | Paul S. Warren - WA9ZDL       |
|                                                     | J. W. Heater, Amirillo, Texas |

We also thank the many others who made financial contributions to assist the AMSAT-OSCAR-C and AMSAT-OSCAR-B projects.

---

#### AMSAT Board of Directors Meeting

March 1, 1973

The Board of Directors meeting was called to order by President Klein at 8:18 p.m. at the home of Charles Dorian.

In attendance were Perry Klein K3JTE, Bill Tynan W3KMY, Charles Dorian W3JPT, Bill Hook W3QBC, Ray Soifer K2QBW, Dick Daniels WA4DGU, John Gregory W3ATE, Cap Petry W3AWN, and Tom Mitchell WA3TBD.



President Klein reported on the results of the recent ASSC meeting. A draft copy of the minutes was circulated for the Board to read. Continued participation in the ASSC was concurred in.

Discussion followed the present status of OSCAR 6. It was agreed to continue the 4 days (Friday - Monday GMT) on and 3 days off schedule. The beacon is to be kept in the telemetry mode and Codestore only used for special purposes. The Codestore loader at Talcott Mt. is to be returned for overhaul and use in the Washington area.

Bill Tynan reported on the current status of Skylab and possible amateur involvement.

Approval was given for an AMSAT representative to go to the Dayton Ham-vention in April and the Rochester VHF Convention in May to speak on AMSAT matters.

Material for the March issue of the Newsletter was solicited.

John Gregory reported on net activities and advised the present schedules would continue until further notice. He also advised that the AMSAT "hotline" was being called from 185 to 255 times per week.

Bill Tynan advised that work is continuing on the local AMSAT repeater.

#### AMSAT Board of Directors Meeting

April 28, 1973

The Board of Directors meeting was called to order at 10:30 a.m. at the home of Perry Klein.

In attendance were Perry Klein K3JTE, Dick Daniels WA4DGU, Bill Dunkerley WA2INB, Bill Hook W3QBC, George Kinal WA3TRL, Jan King W3GEY, and Bill Tynan W3KMY.

A discussion was held on the policy regarding reimbursement of automobile travel expenses. Bill Dunkerley recommended that the policy be consistent with ARRL policy and this concept was approved. The rate is 10¢ per mile, or the equivalent air fare, whichever is lower. Prior board approval will be necessary. Lodging but no meals are included. The policy covers local travel, but applicants should use judgment and discretion, considering modest amounts as a goodwill contribution to the cause.

Perry Klein reported on the visit by Jan King and himself to the offices of American Satellite Corporation concerning contending claims to the use of our trademark "AMSAT." The various alternatives are for us to essentially sell them rights to exclusive use of the mark, work out an arrangement for both organizations to use it (dual use), or retain "AMSAT" for our exclusive use. The topic was tabled pending a formal reply from American Satellite Corporation to our correspondence. AMSAT has filed in opposition to American Satellite's attempted registration of our trademark.

Discussion was held as to which day we should have our annual meeting. It will be held in conjunction with the Roanoke Division convention on September 14-16, which includes a technical symposium on space communications. Chuck Dorian is in charge of the activities in connection with the ARRL Technical Symposium to be held in conjunction with the Roanoke Division Convention and will make the final determination.

Jan King introduced the topic of a proposed airborne repeater test of the DJ4ZC repeater prototype by the JPL club. August 25 is scheduled for a pre-flight; the actual test flight will be Sept. 22. The board approved AMSAT support on a 50/50 basis up to \$100 maximum. The JPL club will make all arrangements and handle all publicity, however.

A discussion was held about the recent incorporation of AMSAT (Germany), A. G. The relationship between AMSAT (US) and AMSAT (Germany) is not clearly defined at this time. While they might become a member society of AMSAT (US), the status of DARC, which is a member society of AMSAT (US) would then be somewhat ambiguous. Jan King was requested to discuss and coordinate this matter on his upcoming trip to Germany.

Bill Dunkerley pointed out that there have been rumors that OSCAR 6 was near the end of its operational life. These rumors are not based on any real facts. Nevertheless, a consistent and less confusing operating schedule is needed. Jan King suggested one day on, one off, but this would result in opposite schedules from one week to the next. A different schedule, namely Thursday, Saturday, and Monday (GMT) on was suggested and agreed upon. This is tentative, of course. It was also decided to adopt a policy of bulletin broadcasts over the satellite at 29.5 MHz and VE2BYG, K1HTV, W3TMZ and K7BBO were designated as AMSAT official bulletin stations. Perry Klein mentioned that additional funding was needed by one of our control stations. An additional \$100 was allocated, and separate attempts will be made to obtain improved antennas also required by that station either by contribution or at discount.

A request for supplemental funding from ARRL was discussed. A request will be submitted to the July ARRL board meeting.

Bill Hook alluded to complications in accepting new memberships at hamfests where AMSAT has representation. However, Bill Tynan pointed out that there is an important "enthusiasm" or "impulse buying" factor involved. The majority of the board seemed to agree that the policy of signing up members at these meetings should be continued. Bill Hook will make up a "packet" or "kit" to minimize the difficulties in the future.

Receipt of a letter proposing the establishment of a Petry memorial fund was acknowledged. This is the idea of W8IRG and was approved with the understanding that it will be administered by him.

Bill Dunkerley discussed the progress of the educational program developed by ARRL and Talcott Mountain Science Center, and the critical importance of the continued availability of a working satellite. He asserted that if the probability of having a working satellite is not high for next year, the educational program will have to be phased down. Bill Tynan suggested that AMSAT take the position that the educational program be continued with the same emphasis. Perry Klein and George Kinal made comments to substantially the same effect. The problem appears to be that it is difficult to say whether OSCAR 6 will still be in operation throughout the 1973-74 school year, and A-O-B cannot be accelerated in time for launch much earlier than the second half of 1974. Bill Dunkerley then recommended that a decision to develop a replacement satellite must be made if the educational program is not to be jeopardized. Furthermore, the League feels that the educational aspect is most important in the field of satellite communications. However, Perry Klein and Jan King felt that an interim satellite effort would retard the A-O-B program. It appears that two avenues for launching amateur repeaters in the near future exist, and so a compromise was agreed upon which would accelerate procurement of one or more two-to-ten meter repeaters. These would then be "on the shelf" for immediate availability should a special launch opportunity arise with a short lead time. The hiring of a skilled technician to perform the rapid assembly was authorized.

Larry Kayser and his group in Canada have proposed to construct a 435 MHz beacon for flight on A-O-B. The proposed project was approved on the same terms as all other A-O-B experimenters, namely that specifications must be met. There was no consensus on whether they could be promised the flight use of this beacon, some feeling that if a substantially higher quality beacon were received from another experimenter, it should be used instead. George Kinal pointed out that the specification is quite rigorous, and the chances of a different design being far superior to the one in question are quite remote. Therefore, Mr. Kayser's group will be given highest priority of flight but not 100% ironclad assurance.

A beacon system at 2304 MHz has also been proposed by the San Bernardino Microwave Society for flight. A possible difficulty is that this band does not have international approval for amateur satellite use. Bill Dunkerley pointed out that Radio Regulation 115 could be used to justify operation. Perry Klein said that a request to the FCC has been made for approval, and that the positive command feature would eliminate many objections.

The meeting was adjourned at 7:45 p.m.

George Kinal, WA3TRL

#### IN MEMORY OF OUR FRIEND CAP PETRY

by Lowell Croysdale, W8IRG

March 26th may soon be forgotten but like the immortal Lincoln stated at Gettysburg: "The world may soon forget what we say here, but will long remember what we did here." On this date the amateurs of the world lost another extraordinary man -- the late Cap Petry, W3AWN, passed away in Hong Kong, China.

The press releases, for the first time, revealed to many of us who knew Cap, his accomplishments in the business world of radio and electronics. Like many of the other Silent Keys, Cap never bragged on the air or in personal contact of his business success.

Cap was born in Bowells, North Dakota, 67 years ago. In 1932 he became communications engineer for United Air Lines, and along with Herb Hoover, Jr. and others spearheaded that great advancement in modern communication. Later he was advisor to the New York Port Authority where he assisted in the communication planning of the original La Guardia Airport. Being a pioneer in air traffic control, which was adopted by United, American, and TWA, he was well known in Washington. This latter recognition caused him to be sent in 1945 to foreign countries for the Chief of Staff as American representative at the rank of Colonel. At his retirement last year he was special assistant to the president of Aeronautical Radio, coordinating future planning of satellite communication with NASA as well as other government agencies.

Licensed in 1921, Cap had long ago received the fifty year award. In the years as an amateur he organized and was the first president of the Dayton Amateur Radio Club. Later he organized the Arinc Amateur Radio Club. A supporter of AMSAT, he was one of the original directors and greatly responsible for organizing the worldwide net of hams interested and reporting on OSCAR. You might also say he had his private net, of some twenty former Daytonites, and others which met twice to three times weekly to keep alive that bond of personal friendship enjoyed in their days of living in Dayton. The recent Dayton Hamvention paid tribute to him and those left behind carried on his Amateur Space Communication Forum.

Never to be forgotten by amateurs all over the world is that Friend Cap, a truly Al operator respected by all and admired for his interest and humanitarian response to any and all he heard. During illness and tragedy, which befell many of us, Cap was always around with personal condolence and thoughtful encouragement. On the air, and in personal contact with him, amateurs rallied around and received advice, counsel, encouragement, and instruction. Many of today's operators remember his patience and assistance during the agonizing years of getting a novice license and that valued assistance going up the ladder in our amateur world.

In conclusion, quoting his brother, Edwin, "He was a builder and a hard taskmaster, most of all on himself, as he always strove for perfection. He was always gracious and appreciative of the smallest things." And all amateurs are indebted to his lovely wife, Florence, who so graciously shared his time with us all during the years.

## OSCAR 6 Operating Schedule

By Bill Tynan, W3KMV

The regular operating schedule of OSCAR 6 is now as follows:

- ON -- Available for two-way contacts:  
0000Z - 2400Z Thursdays, Saturdays and Mondays.
- OFF -- or if ON, not available for two-way contacts:  
0000Z - 2400Z Fridays, Sundays, Tuesdays and Wednesdays.
- ON -- not available for two-way contacts for about three minutes about ten minutes after the first ascending node (S-N equatorial crossing) on each scheduled OFF day. This operation is for the purpose of collecting telemetry data. Those copying telemetry data at any time are urged to send the raw numbers to:

AMSAT Telemetry Data Dept.  
P. O. Box 27  
Washington, D. C. 20044 USA

Modifications to this schedule will be made should it become necessary or if special operating situations make it desirable. Also, the operating schedule may be extended for DX-peditions and other worthy causes.

Word on schedule changes and other pertinent data can be obtained from any of the following sources:

AMSAT Nets (See Page 2)  
AMSAT Hot-Line (301-654-1166)  
WLAW Bulletins (See QST)  
AMSAT Bulletin Stations VE2BYG, K1HTV, W3TMZ and K7BBO  
(These stations transmit on the satellite on about 29,500 kHz on the reference orbits.)

## SATELLITE OPERATING AWARDS

By Raphael Soifer, K2QBW

To pirate somebody's recent ad for SSTV gear, OSCAR 6 really is "the newest activity in amateur radio." As of May 1973, no less than five awards have been offered for OSCAR work, ranging in difficulty from the most basic to the nearly impossible. Here are the details, in approximate order of difficulty:

### Satellite Communicators' Club (S.C.C.)

Sponsored by AMSAT, this attractive certificate is offered to any licensed amateur station making a two-way contact through the OSCAR 6 satellite. To receive yours, send QSO details including date, time (GMT), station worked, modes and signal reports for both stations to AMSAT, Telemetry Department, Box 27, Washington, D.C. 20044. There is no fee, but an SASE marked "Satellite Communicators' Club" would be appreciated. A special OSCAR 6 QSL card will also be enclosed, if you haven't already received one. If possible, please use the "OSCAR 6 Communication Report" form for reporting your contact(s).

### WVE Satellite Award

Sponsored by the Northern Alberta Radio Club, this award (Worked Canadian VE Call Areas Via Amateur Satellite) is designed primarily to develop a

greater interest in amateur satellite communication. The Award is available to any licensed amateur in the world. W/VE stations must contact, on any mode, any four Canadian call areas (VO1, VO2, VE0, 1, 2, 3, 4, 5, 6, 7, 8) via an amateur satellite. DX stations, including KH6 and KL7, must contact any two such Canadian call areas. Only contacts after January 1, 1973, will qualify for this award. An application will consist of the required QSL cards accompanied by a fee of 25 cents for W/VE or one IRC for DX stations. Include sufficient IRC's if cards are to be returned by registered mail. Send cards and fees to the Committee Chairman: Ray J. Nadeau, VE6SF, P. O. Box 52, Barrhead, Alberta, Canada.

#### Satellite DX Achievement Award ("1000")

Sponsored by ARRL, the "1000" recognizes two-way communication via OSCAR 6. To qualify, a station must accumulate 1000 points as follows: Each contact with a new station counts 10 points, each new country counts 50 points, each new continent counts 250 points. For example, the first European contact for a W/VE would normally count 310 points -- 250 for the new continent, 50 for the new country and 10 for the new station. A station having 15 different stations (150 points), 3 countries (150 points) and two continents (500 points) would have a total of 800 points and still need 200 to qualify. QSL cards must confirm 2-way communication via OSCAR 6, contain a date of December 15, 1972, or later, plus usual QSL information. Photocopies of the QSLs are not acceptable. Only one contact per station, regardless of mode. Postage of one dollar is required if you wish cards to be returned via registered mail. When you're about ready to apply for the award, request the appropriate application form from ARRL Headquarters, 225 Main Street, Newington, Conn. 06111.

#### OSCAR 6 WAS (Worked All States)

Sponsored by AMSAT, this award has yet to see its first claimant. Regular ARRL rules for Worked All States apply, with the following exceptions: WAS Rule 3, prohibiting contacts made through repeater devices, is of course waived, and is replaced by a rule requiring all QSL cards to confirm two-way communication via OSCAR 6 on or after October 15, 1972. There is no fee, but sufficient postage should be sent to cover return of the cards. To apply, secure a copy of the WAS application form (Operating Aid No. 8) from ARRL Hq. and send it, with your 50 QSL cards, to AMSAT, WAS Award, P. O. Box 27, Washington, D. C. 20044. Please note that this is an AMSAT award, not an ARRL award, and endorsement of ARRL WAS to show satellite operation is not available. The form of the award has not yet been decided, but it will be suitably impressive.

#### CQ DX Award OSCAR Endorsement

Sponsored by CQ Magazine, this award likewise has yet to be won. As an endorsement, it is available to holders of the CQ CW or SSB DX Award. To qualify 50 countries must be worked and confirmed via amateur satellite since November 15, 1945; be advised that any cards submitted showing dates before March 9, 1965, will be carefully scrutinized, hi! Rules are, in all other respects, the same as those for the CQ DX Awards; note that while single-mode confirmations are necessary for the basic DX Award and for country endorsements, confirmations submitted for the OSCAR Endorsement may be on any mode. Further information may be obtained from CQ, 14 Vanderventer Avenue, Port Washington, New York 11050, or from K4IIF, WA6GLD or a member of the CQ DX Advisory Committee in your area.

AMSAT is pleased to publicize these awards because they assist in stimulating activity via OSCAR 6. As for this writer, he still needs one Canadian call area, 19 states and 43 countries. We hope you're doing better!

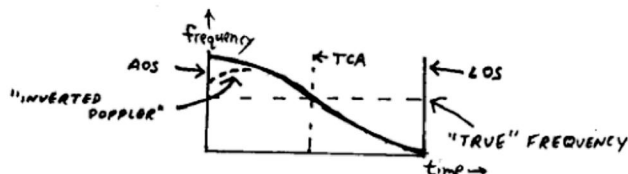
# PRELIMINARY OBSERVATIONS ON OSCAR 6 INVERTED DOPPLER

By Ron Dunbar, WØMJS and John Fox, WØLER

Editor's Note: A more complete report on this subject will be presented by the authors at the technical symposium mentioned elsewhere in this issue.

The flight of OSCAR 6 has been a tremendous success; it has challenged the imagination and ingenuity of countless individuals by presenting the opportunity to devise and test new modes and methods of VHF communications, simple yet extremely reliable telemetry systems, accurate ranging systems utilizing commonly available equipment, new methods and findings in the area of propagation research, as well as countless other benefits.

It is this last subject, propagation, which we will address in some depth, concerning a UHF propagation anomaly first discovered while observing the 435.1 MHz telemetry beacon aboard OSCAR 6. For lack of a more descriptive term, we have chosen to christen the anomaly "INVERTED DOPPLER."



Under normal circumstances, if one plots received frequency versus time for one satellite pass, a curve similar to the one depicted above by the solid line will result. With only minor variations, this curve is representative of that which is predicted by the "Doppler Effect" theory. The apparent shift in frequency is due to the change in the satellite's velocity relative to the observer on Earth. Although many factors influence the amount of apparent frequency shift (such as tropospheric and ionospheric effects, variations in electron density and the plasma surrounding the satellite itself), all these combined effects will normally create a shift of only 40 Hz or so at a frequency of 400 MHz according to theory. Therefore, the effect may be practically stated in a slightly simplified form as follows: As the satellite approaches the observer, its velocity is added to the velocity of propagation of the radio signal, creating an apparent upward frequency shift on the order of 8 kHz above the true (transmitted) frequency at 435 MHz. The amount of upward shift gradually but steadily decreases until the instant when the satellite is nearest the observer, or "TCA" (Time of Closest Approach). Its velocity relative to the observer is then zero, and at that instant the observed frequency is the same as that transmitted from the satellite; i.e., no frequency shift, either up or down.

As the satellite recedes from the observer, its velocity is subtracted from the velocity of propagation, resulting in a total apparent downward frequency shift of approximately 8 kHz, for a shift during one orbital pass of  $\pm 8$  kHz, or 16 kHz total.

This normal effect had been noted on all previous OSCAR satellites. However, on October 24, 1972, WØLER (John Fox, Minneapolis) noted an unusual occurrence immediately following AOS (acquisition of signal) on Orbit 118. Instead of the normal downward frequency shift, the signal was climbing in frequency at a rapid rate. The climbing effect gradually decreased, stopped, and then was followed by normal Doppler shift for the duration of the pass. Since no one else in the Minneapolis area was tracking the 435 MHz beacon at that time, WØLER was unable to verify the observation and assumed the

strange behavior to be caused by drift in his receiving system. A thorough equipment check revealed no malfunctioning components, however. Subsequent orbits occurring later that evening exhibited only normal Doppler characteristics.

The following evening, the same upward shift was noted! This time, both the amount of upward shift, as well as the duration of the effect were measured and recorded as being approximately +450 Hz and 7 minutes following AOS.

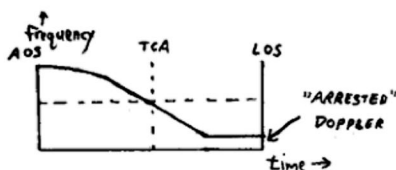
At this juncture, WJLER contacted WJMJIS (Ron Dunbar, Minneapolis) who had been observing signals on the 146/29 MHz translator aboard OSCAR 6. After discussing the anomaly at length, WJMJIS proceeded to perform modifications to his receiving equipment which would allow reception of the 435 MHz beacon.

With two tracking stations now in operation, the rate of data collection was greatly increased, and with the stations on a North-South line only 25 miles apart, it was readily verified that both stations observed exactly the same phenomena.

After approximately three weeks of tracking and data analysis, it became evident that the Inverted Doppler anomaly was roughly confined to an equatorial crossing between 60°W and 90°W longitude. Due to the painfully slow eastward precession of the orbits, it was not possible to closely define the exact boundaries of the effect at this time.

Further analysis revealed that the duration of the effect was related to equatorial crossing time and showed an average duration of approximately 7.5 minutes past equatorial crossing on the northbound nighttime passes of OSCAR 6.

Our attention was then turned to the southbound daytime orbits passing over the same area in which the effect had been noted on the northbound passes. We anticipated that we would see an "Arrested Doppler" effect on the southbound passes; i.e., we expected the Doppler curve would be perfectly normal from AOS through TCA, but as the satellite approached the equator and LOS (Loss of Signal), we had reasoned that the normal downward shift, algebraically combined with the anomalous upward shift would probably cause the observed shift to be zero; i.e., the normal downward shift would appear to be "arrested" (see drawing below).



Extensive investigation proved fruitless. Absolutely no abnormal effect was observed on the southbound daytime passes, even though they crossed exactly the same area as the nighttime passes had.

Continued investigation of the nighttime passes resulted in further refinement of the available data. The effect was found to encompass an area between 50°W and 105°W longitude as observed from our location in Minneapolis (45°N, 93°W). The magnitude of the upward shift varied from 20 Hz to 550 Hz, with the greatest majority of measurements falling in the range of 200-500 Hz. Duration of the effect past equatorial crossing averaged 7.43 minutes, with 91% of the readings falling within the range of 6-9 minutes.



Due to operational procedures designed to conserve battery power, OSCAR's 435 MHz beacon was not run continuously, leaving several gaps in our data. We then turned to reception of signals from the NOAA-2 Weather Satellite operating on 137.5 MHz in order to speed up data collection. (NOAA-2 was launched by the same vehicle which carried OSCAR 6; therefore, both satellites were in an essentially identical orbit.)

Results were negative on 137.5 MHz. Several concurrent tests were conducted by tracking OSCAR 6 on 435 MHz and NOAA-2 on 137.5 MHz. Even though the two satellites were only 20 minutes apart, with practically identical equatorial crossings, no Inverted Doppler was noted on NOAA-2's signal, even when it had been observed only 20 minutes earlier on 435 MHz.

These new findings led to the suspicion that the upward frequency shift might be caused by oscillator drift in the OSCAR transmitter, probably resulting from thermal effects associated with the satellite's passing from sunlight into the Earth's shadow.

Two other stations who had been tracking the 435 MHz beacon were then contacted; W4PJ (Ted Mathewson, Richmond, VA) and W5SXD (Dick Allen, Houston, TX). Neither station was able to detect the anomaly that was being observed at our more northerly location. One possible explanation is that the anomalous effect may occur near TCA for these stations, at which point it would be most difficult to detect.

When the 435 MHz beacon's output power dropped drastically on orbit 1081 (1/10/1973), we immediately built equipment for the 400 MHz satellite band. After a week of construction and testing, we commenced tracking operations on 400 MHz. We soon discovered that most of the satellites in that band are only turned on for short periods in order to retrieve stored data and then immediately shut down, yielding no data useful for our purposes.

Finally, after many fruitless hours involved in tuning, tracking, calculating of orbits, etc., we experienced success on January 30, 1973. Inverted Doppler was observed on a satellite named Copernicus, operating on approximately 400.562 MHz. Spurred on by this new evidence, and assisted by many other amateurs who suggested possible frequencies, satellites, and orbital parameters, we finally located a group of five satellites which were in continuous operation and in a near circular orbit inclined only  $\pm 2^\circ$  off the poles. These satellites are a part of the Navy's "NavSat" (Navigational Satellite) System, transmitting on 149.988 and 399.968 MHz simultaneously, by multiplying a common frequency source at 49.996 MHz times 3 and 8. One important difference between these satellites and OSCAR 6 is their orbits' relation to solar time. At the time we commenced tracking the NavSats, their northbound pass occurred in the *daytime*; southbound at *night*; exactly the opposite of OSCAR 6!

The "Arrested Doppler" was indeed observed on the *southbound nighttime* passes, occurring almost exactly as predicted earlier! The normal downward shift merely tapers off and ceases, followed by several minutes of absolutely stable, steady signal until LOS! Absolutely no abnormal behavior was observed on *northbound daytime* passes.

Now came the task of refining our measurements of the orbital period of the five satellites. Accurate calculations concerning the time of equatorial crossing also had to be generated from sequential TCA observations.

Finally, all the necessary data was collected and a new set of computer listings containing orbital predictions was rapidly prepared by WØRLI (Hank Oredson). As the fates would have it, the effect ceased abruptly on the next day, February 5, 1973! As of May 5, 1973, the effect has not been observed again at this location.

Since that time, we have continued the research by reviewing any material even remotely associated with possible causes of the Inverted Doppler effect. One very promising item which recently came to light is contained in Part 2 of an article by Dr. Roger Harrison, VK2ZTB, of the Ionospheric Prediction Services Division of the Commonwealth Bureau of Meteorology in Darlinghurst, Australia. The article was printed in the February 1973 issue of the VHF Communicator, and is entitled "VHF TransEquatorial Propagation."



There appears to be several possible correlations between the Inverted Doppler effect and an effect mentioned by Dr. Harrison, called "Evening," or "Class II" TEP (TransEquatorial Propagation). In the article Dr. Harrison mentions that Class II TEP "shows a maximum occurrence between 2000 and 2300 LMT (Local Mean Time) with a pronounced peak for different seasons and particular paths." (OSCAR 6's northbound equatorial crossings occurred at approximately 2049 LMT.) He further states that maximum Class II TEP occurs during December and January from North and South America. The magnitude of the Doppler shift observed in connection with Class II TEP is definitely in the right ballpark. Further, VK2ZTB says that "Class II TEP is dependent on many factors (season, sunspots, geomagnetic latitude, etc.) that seem to have no bearing on true scatter mode propagation." He also offers the possibility that "Class II TEP is probably supported in some way by field guided ionization; the closer a ray can be launched to tangency with the magnetic field, the more favorable are its characteristics; i.e., higher frequencies will be supported." This last statement may well hold valuable clues concerning the Inverted Doppler anomaly!

At this point it would seem beneficial to summarize some of the findings concerning the anomaly:

1. Inverted Doppler is apparently a nighttime effect.
2. Inverted Doppler is apparently a seasonal effect, perhaps centered on the Winter Solstice.
3. Inverted Doppler seems to be frequency selective, since its effect was never observed at 137.5 MHz.
4. Inverted Doppler effect apparently ceases when the satellite reaches the vicinity of 23.24°N latitude (average) computed from the satellite's velocity and the average duration of the effect. (The Tropic of Cancer is located at 23.5°N latitude.)
5. The apparent eastern boundary (from Minneapolis) at 50°W longitude is explained by the fact that orbits crossing the equator further east than this point would have been more than 7.5 minutes north of the equator before we acquired the signal. This explanation does not, however, satisfy the western cutoff at 105°W, since we should still receive some part of the first 7.5 minutes past equatorial crossing out to approximately 123°W.
6. There may be a possible correlation between maximum shift magnitude and minimum "A-Index" as shown in Solar Geophysical Reports. More data is necessary to confirm this theory.

Our investigation continues, utilizing data gathered by research satellites such as ARIEL I (NASA SP-119), giving us profiles of electron, ion, and magnetic effects in the area of interest. No conclusions have been reached; however, theories abound. WYLER and WYMJS welcome any offer of assistance in the effort, since several questions still must be answered:

Do observers further east or west, but located near 45°N latitude observe the effect?

How far south is the effect detectable?

On what dates does the effect commence and terminate?

Is it somehow related to Class II TEP, and are both effects related to the "A-Index" and Solar conditions?

Could VHF/UHF communications via this mode be possible over vast distances?

The list of questions is endless. We solicit reports from any stations which were involved in tracking the 435 MHz beacon on OSCAR 6, be they positive or negative. All reports will assist in pinning down the area of the effect, and will be most welcome.

Ron Dunbar, W0MJS  
110 S. Heritage Circle  
Burnsville, MN 55337

John Fox, W0LER  
321 109th Lane NW  
Coon Rapids, MN 55433

---

#### NARROW-BAND FACSIMILE THROUGH OSCAR 6

By E. R. Angle, WA6GUY, and  
E. L. Arnn, WA3FVG/6

To date, and our knowledge, this is the first recorded successful transmission and reception of a facsimile picture through an amateur satellite.

To accomplish this, certain design goals were set forth.

1. Low duty cycle -- non-audio tone modulated carrier. For satellite power conservation.
2. Narrow bandwidth -- to minimize QRM. A signal compatible with high speed teletype.
3. Simplicity of generating signals -- within the capability of most hams.
4. Compatibility with normal receiving equipment -- tuned as a CW signal.

With the following system we met these requirements. Refer to block diagram. Basically, a CW transmitter is keyed on and off by a fax signal such that a spot on the fax paper produces a CW keyed output. This signal is transmitted (WA6GUY) to the satellite, sent back out on the down-link, received (WA3FVG/6) as if a CW signal and fed into the receiving fax machine.

Standard desk fax units were used for transmission and reception. Various message formats were tried. Typewritten material was selected for half of the picture since fading of OSCAR 6 signals previously proved to be quite rapid with existing antennas. It requires five seconds for a single typewritten line to be transmitted. The other half of the picture used larger characters for better contrast definition in the event signals were strong over the entire two minute twenty second period required for a complete picture. It's also easier to resolve.

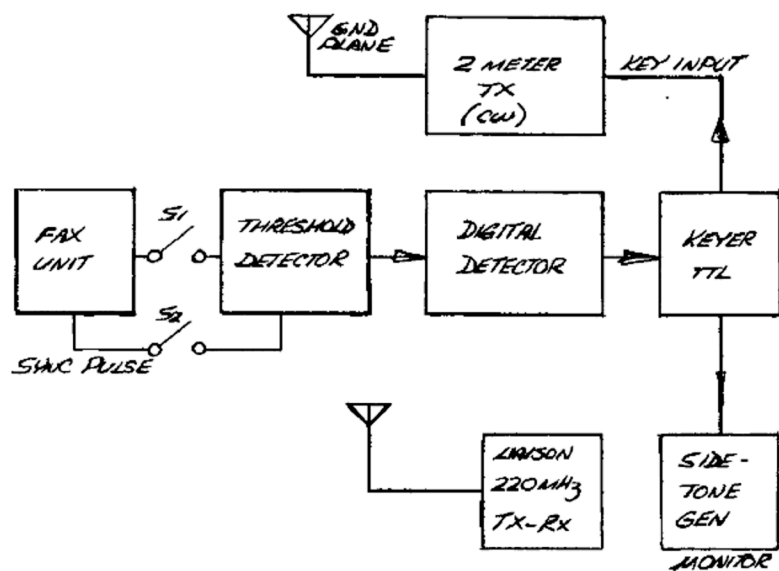
See schematic diagram. Video out of the fax unit is normally of negative polarity and is amplitude modulated on a 2400 Hz carrier.<sup>1</sup> It is fed to the threshold detector where it's compared with an adjustable DC voltage (threshold) and inverted, thus producing positive video, meaning, a black line on the message gives a positive signal out whenever the input is larger than the threshold voltage. This signal is bursts of 2400 Hz square waves. The signal is then run into the digital detector which is a one-shot multivibrator with its pulse width set for one and one-half cycles of 2400 Hz, resulting in a maximum system bandwidth of 1 KHz.<sup>2</sup> The output (Q) of the one-shot goes high when 2400 Hz is present at its input. However, because of the pulse period, no 2400 Hz is present. The output is TTL

---

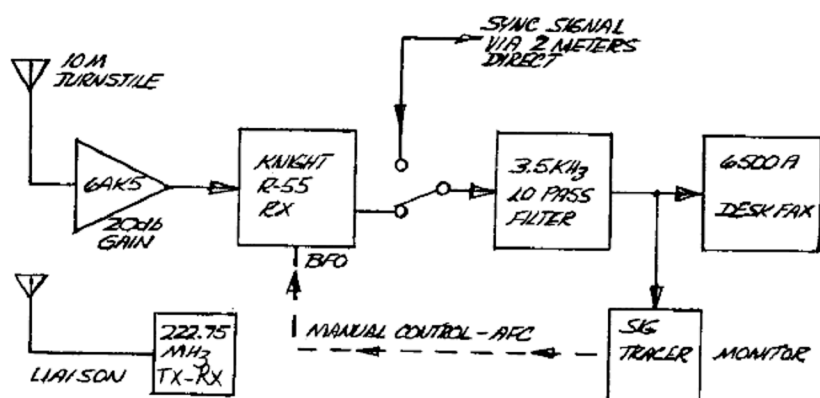
<sup>1</sup>"Conversion of Telefax Transceivers...", QST, May 1972, p. 23.

<sup>2</sup>"Reference Data for Radio Engineers," Fifth Edition, ITT, 1972, p. 1-20.

# OSCAR SIX FACSIMILE TRANSMITTING SYSTEM



# OSCAR SIX FACSIMILE RECEIVING SYSTEM



compatible as is the keyer used here. CW keying or fax signals will produce an output keying of the keyer. All keying is solid-state because some of the smaller lines on the picture produce pulse widths as short as one millisecond. Relays aren't usually this fast and they produce contact bounce, not very desirable here. Transmitter keying characteristics are important in that they should be slightly rounded off but not excessively or video on short pulses will be lost. With too fast a rise time the key clicks of the signal will be excessive.

Sync pulses are obtained from the sync contacts in the fax machine. They run directly to the threshold detector strobe input. When S2 is closed, a 22 msec pulse appears at the output of the transmitter every time the sync contacts open. This is a useful output since it is low duty cycle and it gives the receiving station a signal by which to track under conditions of fading and Doppler. Since the transmitted video pulses are so short they produce little if any perceptible pitch for the receiving station. Bursts of tone shorter than 10 msec have no pitch. Switch S1 disables video during periods of synchronization. Deskfax units don't like the extra pulses while trying to sync.

A good reliable liaison (220 MHz) between transmitting and receiving stations was required for the success of this experiment.

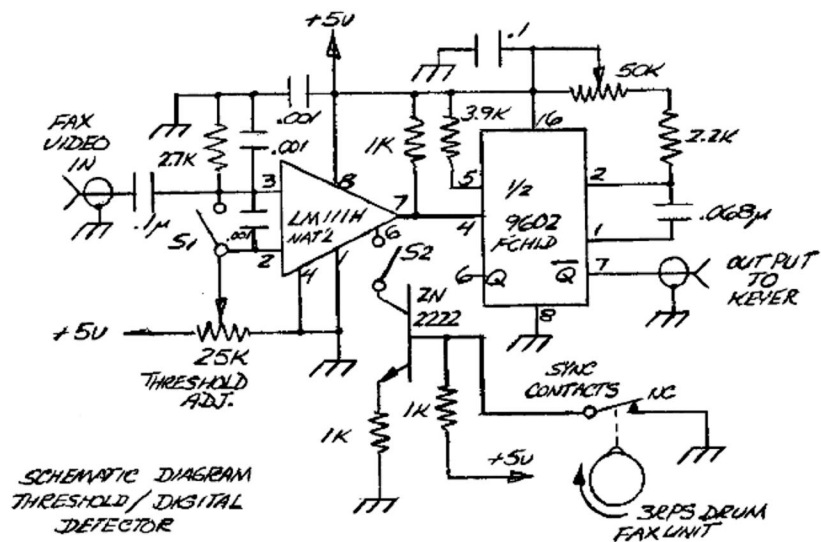
Transmitting equipment consists of a Heathkit Pawnee 2 m transceiver, driving a 4CX250 linear amplifier (Ep 1250 V, Ip max 250 ma) for a DC input of 300 watts. Assuming 50% efficiency, this gives approximately 150 watts output. 1.5 dB feedline loss yields 105 watts to the antenna, a 2 dB over isotropic quarter-wave ground plane; 157 watts ERP. With the satellite at an elevation pointing angle of 45° there is approximately 3 dB antenna pattern loss or in this case, about 75 watts ERP. The enclosed picture was made with the satellite in this approximate position on Orbit #2460.

The receiving system utilized for facsimile via OSCAR 6 reflects the budget-minded nature of the writers. The heart of the system is a venerable, much-modified Knight Kit R-55A all-band receiver. This unit is preceded by a 6AK5 rf amplifier. The 20 dB gain of this amplifier lowers the noise figure of the receiver to 17 dB, allowing antenna (galactic) noise<sup>3</sup> to be heard. The receiver is followed by a 3.5 KHz sharp-cutoff low-pass filter which makes up for some of the shortcomings of the receiver's broad 1650 KHz IF amplifier. The output of the filter is fed to the facsimile transceiver and is monitored by ear using a Heathkit signal tracer to sample the filtered audio. During transmission of the message, it was necessary to listen to the recovered tone and close an AFC loop using the BFO control to maintain the pitch near 2 KHz in spite of Doppler shift and receiver drift. During some tests, a Knight Kit scope was used to evaluate signal quality at the fax machine input. The antenna is a 10 meter inverted-vee turnstile designed to provide circular polarization with good high-elevation coverage.

To save time and insure good message registration on the receiving blank, phasing (synchronization) signals were obtained by copying WA6GUY's 2 meter uplink frequency directly. Thus, the fax machine could be synchronized before AOS (acquisition of signal) or during a deep fade. An intercom link on 222.75 MHz which provided voice liaison proved extremely helpful in coordinating the operation. Confirmation of successful phasing, cries of joy, and tears of frustration were exchanged over this link.

The communication was conducted near the upper end of the OSCAR 6 downlink around 29.54 MHz since this part of the passband is seldom used. At least it seemed so until we tried using it! Some strong CW QRM did raise a cloud of smoke from the fax drum during a pass on 29 April, but generally things were in the clear.

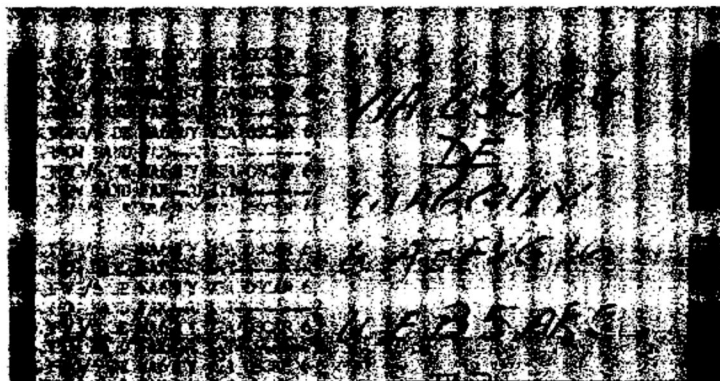
<sup>3</sup>"Reference Data for Radio Engineers," Fourth Edition, ITT, 1960, Fig. 2, p. 764.



WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----  
WA3FVG/6 DE WA6GUY VIA OSCAR 6  
NARROW BAND FAX--AMSAT-----

NB FAX  
VIA OSCAR 6  
DE  
WA6GUY  
WA3FVG/6  
WEB5ARC  
73

TRANSMITTED



RECEIVED

Several obvious steps can be taken to improve the received signal. Among these is repairing the R-55. The vertical lines in the received fax message are 60 Hz power line interference caused by FM in the receiver BFO. Switching BFO tubes has since improved matters by some 12 dB. Another more fundamental change would be to incorporate a bandpass filter in place of the low-pass filter to limit the bandpass to the minimum required by the transmitted signal (less than 1 KHz). Also, since the transmitted signal has no grey scale but represents only black or white, threshold detection could be used to more perfectly recover the signal during periods of high signal-to-noise ratio. Use of a high-gain receiving antenna also comes to mind, but runs counter to our frugal nature. Additionally, there is strong evidence in the received message that the noise level at the output of the receiver fades with the signal from the satellite. This says that the satellite output signal-to-noise ratio limits the system for short slant ranges. Finally, a narrower IF bandpass would remove the audio image and improve the S/N ratio by as much as 3 dB.

Now, some comments on the more obvious (and less obvious) features of the received copy are in order. Firstly, and most obviously, the satellite did a fine job of repeating the words "VIA OSCAR 6." Also obvious are the vertical bars caused by the FM hum in the receiver BFO.

The strong vertical black line at each edge of the message is the sync/manual AFC pulse of 22 msec duration. This pulse is strong enough that synchronization could be obtained via satellite with minimal signal processing. The lighter portions of this bar represent the periods of fade in the received signal. Note the deep fades in the beginning (top) and middle of the copy. A much shorter fade period was observed during an earlier daytime test. The slope of the edge of the sync bar shows that the satellite was getting closer during the transmission. The edge of the bar is nearly vertical at the end of the pass indicating it was nearly TCA (time of closest approach). If the direct 2 meter sync pulse had been written on the receiving blank, a comparison of its position with the position of the received sync bar would allow absolute time delay (and hence range) measurement.

Finally, to return to the transmitted text, the astute reader has probably noticed that there is no evidence in the received message of the vertical line which is so obvious in the original message. This, astute and suspicious reader, is because not all of the deficiencies were on the receiving end! The vertical line and handwritten text on the right were written in blue ink and consequently exhibit less contrast than the typewritten text. The threshold adjustment in the transmitting system is somewhat tricky, and in fact it was set too high to pass the blue vertical line. Many of the partial dropouts in letters such as the W and C in WEB5ARC during periods of good signal are in fact transmitting dropouts due to light printing on the original message.

We would like to express our appreciation to the other members of the WEB5ARC (West End of Building 5 Amateur Radio Club), A. A. Grey, WA6RQP, and R. L. Prakken, K7ZSB, at Hughes Aircraft, for their many helpful criticisms, suggestions and encouragement. Spirited discussions during our noontime meetings aided greatly in the development of the overall concept, video digitizer circuitry, and communication strategy.

#### OSCAR 6 QSL LISTS NEEDED!

Marc Pressman, WB4DRB, has developed a computerized AMSAT OSCAR 6 Communications Information Retrieval System which lists participating stations, states and countries that use OSCAR 6. Updating is done periodically, and all users of OSCAR 6 are invited to send an alphabetized list of the QSL cards they have received for QSOs through OSCAR so that we can bring the user list up-to-date. Reports from stations in IARU Regions 1 and 3 are particularly needed. Please send your list to AMSAT, P. O. Box 27, Washington, D. C. 20044, USA.

Dear Sir:

LETTER

Norwich, England  
March 28, 1973

On Monday, 26th March, Mr. Gowing explained to us about a satellite and he said that it would probably appear that night. As we were standing there Beverley spotted a very dim light moving slightly. Beverley pointed it out to us. We talked a while about it and decided it was the satellite. The next evening we told Mr. Gowing we thought we had seen the satellite and described it to him and showed him where it was. He told us to write a letter to you.

Samantha Nobbs  
Beverley Nobbs  
Ann Goulding  
(Ages 6, 8 and 11 years old)

---

ELEVATION -- HOW IMPORTANT IS IT?

By Wally Lamb, WØPHD

I am sure that all the fellows tracking OSCAR 6 would like to know how to get into it the greatest percentage of the time that it is within their range and with the equipment they have or plan on having. So far we have learned through previous articles on how to figure out where to point the beam (azimuth) and when. The next factor to learn is where to point the beam above the horizon (elevation) and discover if this is really as important as we might think.

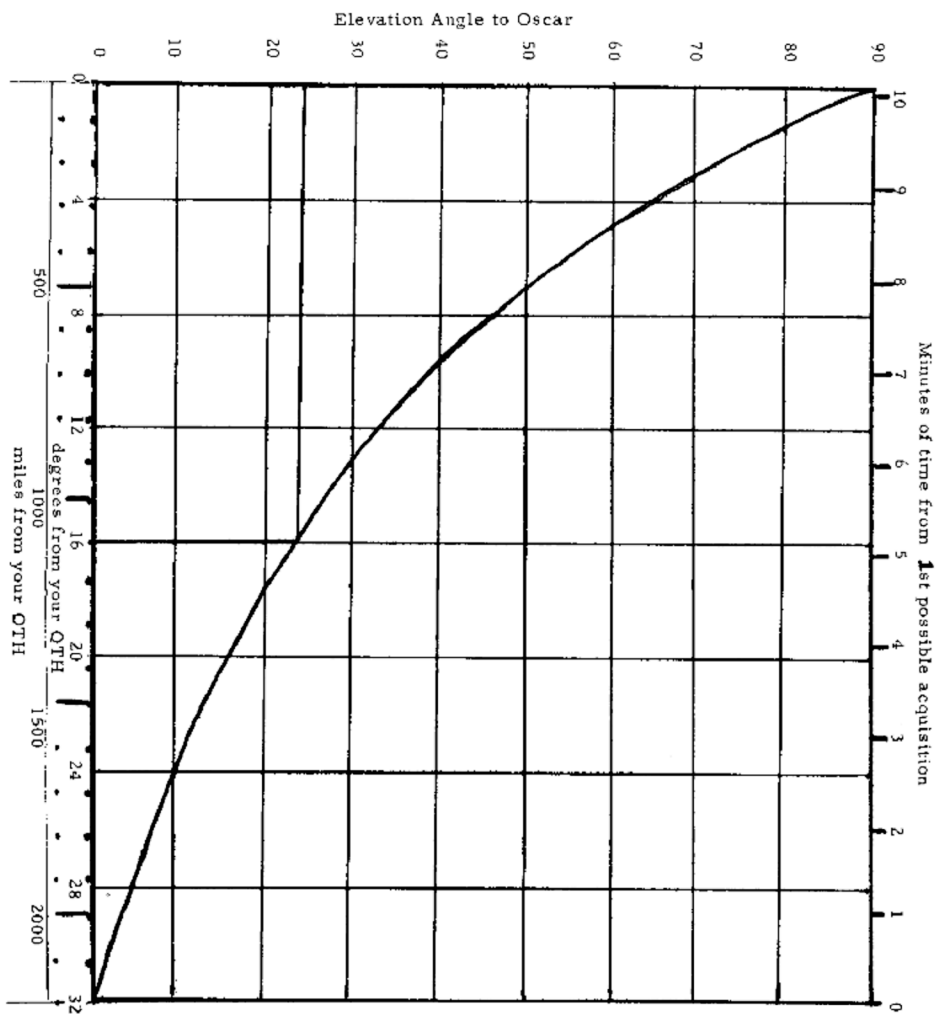
First of all we must realize that any antenna pointed at the horizon does have some coverage in the vertical direction as well. How much coverage in the vertical depends on the gain of the antenna and its polarization. For the sake of this discussion we will assume that you can still get into the satellite when it is at an elevation of 25 degrees above the horizon. If this is the case, then you can hit 50% of the passes within your range 100% of the time. The other passes are only above 25 degrees less than 50% of the time so you can also get into them better than 50% of the time. In total then you can get into all the OSCAR 6 passes that come within your range 75% plus of the total time they are in your area (range) without the need for any elevation control.

The most important thing you can do to upgrade your station's capabilities is to go cross polarization on both receiving and transmitting antennas!

To get the longest time into OSCAR you can elevate your antenna to the point where you start drawing in on your range of first acquisition; going beyond this point will cut down on your total time into OSCAR. In the case of the antenna we have mentioned this would be no more than 20 degrees elevation. You will then gain about 3 additional minutes of QSO time.

Now that you have made these changes and it still appears that you are missing those times when you can't hit the satellite because it is above the elevation range of your antenna, it is time to think about elevating the antenna system. If possible both the receiving and transmitting antenna should be elevated, no small task on a ten meter beam. If you do not want to go that route the next best thing would be to elevate the transmitting antenna only. The elevation should be variable but if that is too much work then the next best thing is to settle on two transmitting antennas, one that is fixed in the horizontal plane and the second fixed at the angle of elevation that takes over where the first beam leaves off. In the case of our example antenna this would be at an angle of about 40 degrees giving you full access to the satellite anytime from the horizon to an elevation of 60 degrees. You will still lose about 3 minutes on a directly overhead pass but the chances are that if you didn't elevate the ten meter beam you would lose it anyhow on the receiving end.

I have found a "Bible" for OSCAR work. It is called *Satellite Tracking* by Stanley Macko and is published by Rider Publications. The graph shown below is calculated on information from this book and the OSCAR 6 parameters.



You find the angle of elevation by knowing the distance the suborbital point is from you in degrees or miles. For an example, we find that when the satellite is half-way to us from the point of first acquisition, a distance of 16 degrees or 1100 miles, OSCAR will appear 24 degrees above the horizon. The time scale on the top shows the time it takes to go from first AOS to overhead on an overhead pass.

For another example, the satellite will be at an angle of 45 degrees when it is 600 miles or 8 degrees from your QTH.